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Series A

U-235 Accumulations in the K-306-7 P. W. Room Exhaust Filters
Short Title of Document

H. F. Henry
Author

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INTER-COMPANY CORRESPONDENCE

(Insert Name) COMPANY Carbide and Carbon Chemicals Division LOCATION Post Office Box P Oak Ridge, Tenn.

TO Mr. J. P. Murray
LOCATION K-303-7

DATE January 9, 1950

SUBJECT U-235 Accumulations in the K-306-7 P. W. Room Exhaust Filters

COPY TO Mr. A. P. Dunlap
Dr. H. F. Henry
Mr. J. R. Largey ✓
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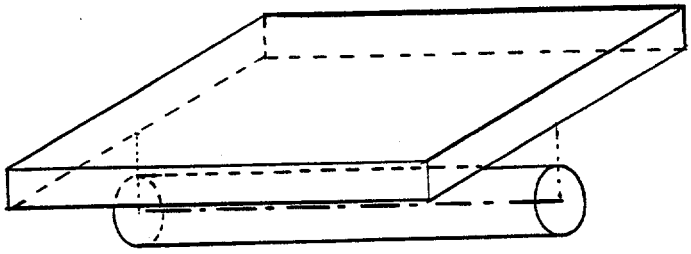
Readings have been taken with the high pressure argon ionization chamber to determine the amount of U-235 which has accumulated in the K-306-7 exhaust filters at the product withdrawal station. On the basis of these readings it is estimated that a total of approximately 1.1 grams of U-235 have accumulated in the filters.

Experimental Data.

The filter is made up of four sections of material, each section being two feet square. To obtain a reading, one section of the filter was removed and was placed on the ionization chamber, as is shown in Figure 1.



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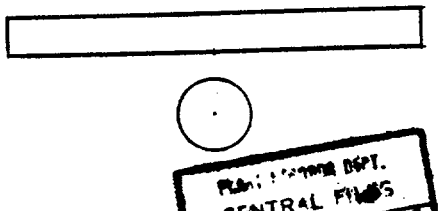

b

Figure 1

Plant Records Dept. CENTRAL FILES REC. C 24415 FILE X-REF X-Ref

The readings with the inlet side and the outlet side of the filter toward the chamber were each .5 μamp.

Assumptions and Calculations.

It can be shown theoretically that the current produced in a line detector by a point source is inversely proportional to the distance

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of the source from the line detector, directly proportional to the angle subtended at the source by the detector, and directly proportional to the quantity of source material. This may be expressed by the relation

$$m = k \frac{n \phi}{d}$$

or

$$k = \frac{d\, m}{n \phi}$$

where

m = instrument reading

n = number of grams of material in the source

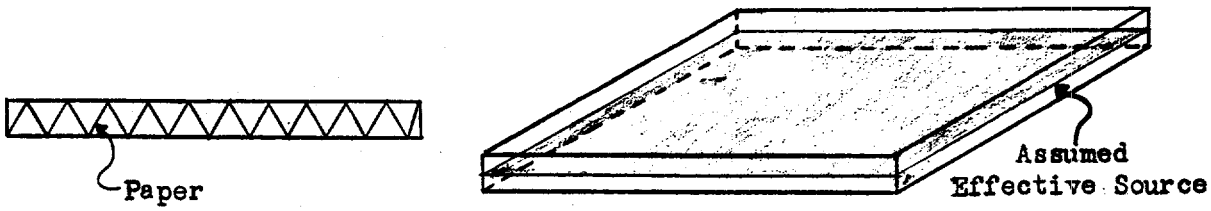
k = constant

ϕ = angle subtended at the source by the detector

d = distance from the source to the axis of the detector.

Using a radium source at various distances from the ionization chamber, a number of readings were obtained, and it was found that the values of $d\, m/\phi$ were very nearly constant. In this case, d was taken to be the distance from the source to the axis of the chamber, ϕ was the angle subtended by the axis of the chamber, and m was the meter reading. It was therefore assumed that the ionization chamber reacts as if it were a line detector located on the axis of the chamber.

The filter itself is composed of a continuous sheet of paper so mounted on a set of forms that it is doubled back and forth, approximately as indicated in Figure 2a.



a b

Figure 2

Because of this construction, it was assumed that the U-235 would not be concentrated at one face of the filter, but would act effectively as if it were concentrated in a plane at the center of the filter. Since the filter was of light material, it was assumed that absorption of radiation by the filter was negligible.

To determine the value of the constant, k, values from a previous experiment[1] were used. From the experiment, it was determined that one gram of U-235 placed on the surface of the chamber and equidistant from its ends would produce a reading of 9.92 μamp if self-absorption within the source were negligible. Since the length of the chamber is approximately 25.8 inches and its radius is 2.15 inches, a source in the position indicated is at a distance of 2.14 inches from the axis of the chamber, and the axis subtends an angle of 161° or 2.81 radians. Substituting these values in the equation for k, we obtain

$$k = \frac{2.15 \times 9.92}{1 \times 2.81} = 7.59$$

The reading from an increment of a plane source, dA, Figure 3, is

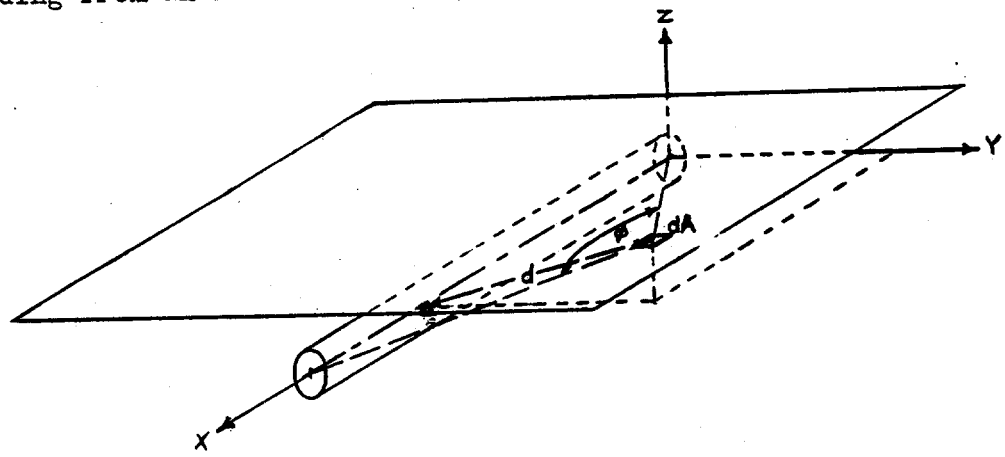


Figure 3

$$dm = \frac{k \sigma \phi \, dA}{d}$$

where σ is the area density of U-235, i.e., the number of grams of U-235 per square inch of filter. Then

$$m = \int_A \frac{k \sigma \phi \, dA}{d}$$

$$= \sigma k \int_A \frac{\phi \, dA}{d}$$

[1] Bailey, J. C., "Calibration of High Pressure Argon Ionization Chamber for Determining Quantities of Uranium in Process Piping, K-511, (to be issued).

Using graphical integration in part, the value of $\int_A \phi/d \, dA$ was calculated for the geometry obtained in these measurements, and found to be 139.2. Substituting this value in the above equation and solving for σ, we obtain

$$\sigma = \frac{m}{139.2\ k} = \frac{.5}{139.2 \times 7.59} = 4.77 \times 10^{-4}\ gm/in^2.$$

The total filter area is 16 ft^2, or 2.3×10^3 in^2, and the total amount of material is therefore approximately 1.1 gm. If other gamma emitters are present in the filter, the amount of U-235 will, of course, be less than this.

Hugh F. Henry

H. F. Henry

HFH:JCB:lja

Radiation Hazards Department

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